

115EE01

# 國立臺北科技大學 115 學年度碩士班招生考試

系所組別：2110 電機工程系碩士班甲組

## 第一節 電路學 試題

第 1 頁 共 2 頁

### 注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Given the circuit shown in Figure 1, find each branch current ( $i_a, i_b, i_c, i_d, i_e$ ) and prove that the total power generated equals the total power dissipated. (20%)

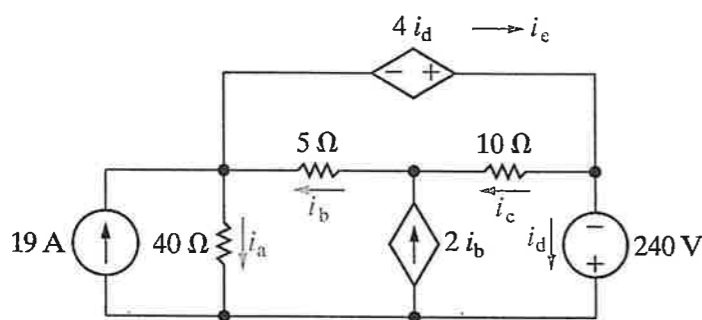


Figure 1

2. The action of the two switches in the circuit seen in Figure 2 is as follows. For  $t < 0$ , switch 1 is in position  $a$  and switch 2 is open. This state has existed for a long time. At  $t = 0$ , switch 1 moves instantaneously from position  $a$  to position  $b$ , while switch 2 remains open. 10ms after switch 1 operates, switch 2 closes, remains closed for 10 ms and then opens. Find  $v_o(5ms)$ ,  $v_o(15ms)$ , and  $v_o(30ms)$ . (20%)

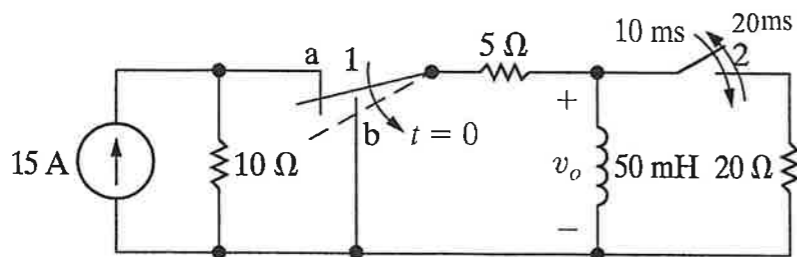


Figure 2.

3. The impedance  $Z_L$  in the circuit shown in Figure 3 is adjusted for maximum average power transfer to  $Z_L$ . The internal impedance of the sinusoidal voltage source is  $4 + j7\Omega$ .
- 3.1 What is the value of  $Z_L$  that will allow the voltage source to transfer maximum power to the load? (7%)
  - 3.2 What percentage of the average power delivered to the linear transformer is delivered to  $Z_L$ ? (8%)
  - 3.3 If  $Z_L$  is replaced by a pure resistor, what is the value of the resistor that will allow the voltage source to transfer maximum power to the load? (5%)

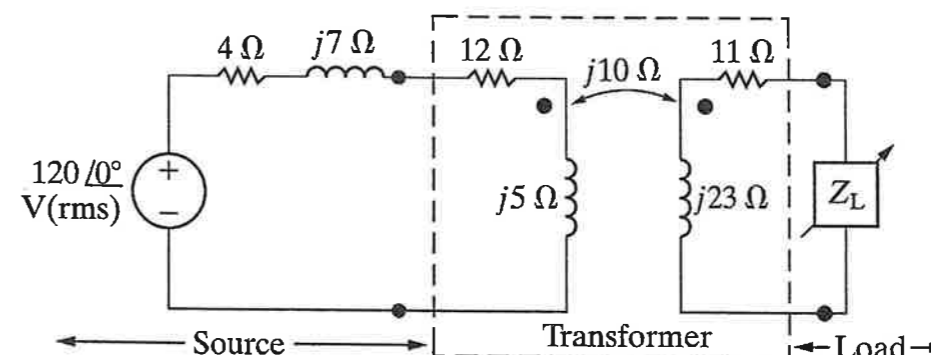


Figure 3

4. A balanced three-phase distribution line has an impedance of  $1 + j8\Omega/\phi$ . This line is used to supply three balanced three-phase loads that are connected in parallel. The three loads are  $L_1 = 120 \text{ kVA}$  at 0.96 pf leading,  $L_2 = 180 \text{ kVA}$  at 0.80 pf lagging, and  $L_3 = 100.8 \text{ kW}$  and 15.6 kVAR (magnetizing). The magnitude of the line voltage at the terminals of the loads is  $2400\sqrt{3}\text{V}$ .
- 4.1 What is the magnitude of the line voltage at the sending end of the line? (10%)
  - 4.2 What is the percent efficiency of the distribution line (based on real power)? (10%)
5. The square wave in Figure 5 has a magnitude of  $4\pi \text{ V}$  and a frequency of 100 rad/s. This periodic voltage is applied to a transfer function:  $H(s) = \frac{s^2 + 25 \times 10^4}{s^2 + 100s + 25 \times 10^4}$ .
- 5.1 Find the first five nonzero terms in the Fourier series representation of the output voltage  $v_o$ . (7%)
  - 5.2 Based on the given transfer function, design a parallel RLC circuit with all variables labeled, where output voltage  $v_o$  represents the voltage across a  $100\Omega$  resistor. (6%)
  - 5.3 Following b), redesign the circuit using active components. Use  $0.5 \mu\text{F}$  capacitors in your design and ensure that the two cutoff frequencies are 100rad/sec and 2500rad/sec. (7%)

注意：背面尚有試題

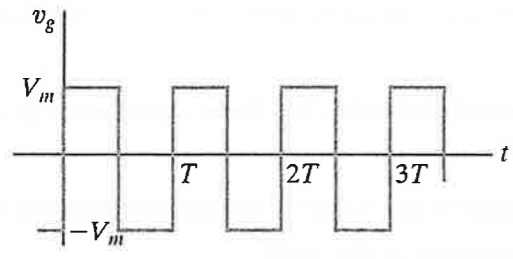


Figure 5